a still higher grade of nuisances than they are in their native countries, of so many different kinds later in the season, we have only one representative in the early spring, the common Dandelion, *Taraxacum officinale.* This plant seems to have decided to conquer the earth, not even respecting the virgin prairie, where it often is smothering most other forms of plant life. Only a few years have passed since its first invasion, but we all understand that it came here to stay permanently.

This being an unusually early spring, with its vegetation three or four weeks in advance of what is produced in an average spring season, a continued chronological enumeration of plants would drift us into the flora of late spring or early summer. As this is quite a complete record of our early spring flora, it proves certainly beyond doubt that this flora is rather deficient in species numerically, and the flowering time for this flora is very variable for different years. However, such disturbances disappear gradually as the season advances, and the equilibrium is restored altogether at or maybe before the end of June. A plant like *Lilium umbellatum,* due on July 1st, knows and obeys this law, and will always arrive on time just when it is due.

Leeds, North Dakota.

Notes on the Seedlings of Bloodroot.

J. A. NIEUWLAND.

Having been fortunate during the season just past in securing typical stages of development of seedlings, I proceeded to examine these systematically with a view of obtaining results worthy of record. A more thorough anatomical investigation must, however, be reserved for future study.

The plants were specimens of the common Bloodroot of our middle western prairie region, which seem to be *Sanguinaria mesochora,* Greene,* or *Sanguinaria canadensis,* Linn., and of the authors in part. This species proposed by Dr. E. L. Greene appears to be somewhat different from the plants of the middle Atlantic States, and of New England and Northern Canada. The flowers of the mature plants, around which the seedlings were found, are comparatively small and almost invariably quadrate, of four large, broad outer petals and four smaller, shorter, and narrower inner ones. The flower has a

* Greene, E. L. Pittonia, Vol. V, p. 306-308.

distinct squarish appearance when full blown. Only once have six petalled flowers been found out of hundreds examined in the last six years, and once too was a four petalled specimen obtained, the petals of the latter being the outer larger ones. Nine petals were once found, the ninth so placed as hardly to interfere with the quadrate appearance of the corolla. These three cases being so rare, I have considered them as teratological.

The foliage of the plants is quite large in fruit, the single leaf in anthesis being about the length of the scape whose flower is enclosed by it. The petiole lengthens out in fruit, and should the latter fail to develop, or be removed the leaf-blade shows a special tendency to increase in size. It is on mature plants almost always seven lobed, round, not broader than long, the apical lobe smallest and the basal ones largest. the whole leaf often six inches in diameter. The relations of the various species of Bloodroot proposed by the above-mentioned author can best be understood from the original publication.*

The Bloodroots are distinctly and exclusively American, and though known before the time of Dillenius,† he seems to be the first botanist of note that recognized the plants as of distinct generic standing. He called the several kinds that he recognized by the name *Sanguinaria.* This name had, however, been used by Pliny and the older herbalists of the seventeenth century for a grass, and so on the basis of strict absolute priority, the name would, after all, be a homonym for Bloodroot. For this reason in 1763, and before 1753 as a "starting point" for botanical nomenclature was dreamed of, Adanson, gave the genus the name *Belharnosia.* The name, strictly speaking valid for the plant, was not taken up, and many do not know that it was given, or why. Bubani‡ in his Flora Pyrenaea restores the Plinian name *Sanguinaria* to our so-called *Digitaria,* and accepts Adanson's name for the Bloodroot.

Linnaeus in his Species Plantarum accepted the Dillenian name, but reduced his several species to one under the Trivial name *Sanguinaria canadensis,* content to designate the others as varieties. This opinion was held up to a few years ago, and the genus was considered as monotypic.

Dillenius** seems to quote Morin as responsible for the

* loc. cit.

† Dillenius, J. Hortus Elthamensis, Vol. 2, p. 21.

‡ Bubani, P., Flora Pyrenaea, (1901). Vol. 4. p. 256.

** The Bloodroots illustrated by Dillenius were of course eastern American specimens and all show the leaves shorter than the flowers in full bloom.

name *Sanguinaria.* The plant was first recorded in the pioneer work on American botany, *Historia Plantarum Canadensium,* of J. P. Cornut, in 1635. He called the plant *Chelidonium americanum flore albo.* John Parkinson†† refers to the plant as *Ranunculus Virginiensis albus.* Robert Morison§§ accepts essentially Cornut's name, *Chelidonium maximum canadense acaulon.* Plunkenet§ recognizing its affinity to the Poppies, called it *Papaver corniculatum, seu Chelidonium humile cauliculo nudo, flore albo stellato.* Dillenius says that the natives called the plant *Pocan,* a name also applied to *Phytolacca* or Pokeweed, in the American colonies.

The seeds of Bloodroot appear to germinate in the fall as well as early spring, especially when warm rains occur late in the season. Several or a dozen plants may usually be found near the older plants while these latter are still in bloom. The seeds ripen in summer early. The seedlings vary somewhat in appearance, size, and development depending upon the condition in which thy germinate, especially nutriment, soil, shade. Injury to the first leaves greatly retards the plants, and two year old plants may be found that are smaller than the plants of the season. The plants, however, immediately begin to replace injured or aborted leaves, and though they seldom have more than one leaf at a time at the end of the rhizome, seedlings with two have been found. Old retarded plants can be easily recognized from seedlings by the presence of several scales at the apex of the rhizome. Replacing of injured or aborted leaves may take place any time if the season is not too far advanced.

Plants germinating in drier sunny places have shorter petioles to their leaves than those growing in shady places covered with the dry leaf mould of last fall. This difference is evident from a comparison of Plates 1 and 2, the former growing in more sun-exposed places and clayey soil. The plants in each are arranged from left to right in order of age. In the second row of Plate 1 is a two leaved specimen and next to it a seedling that had three cotyledons.

The cotyledons of Bloodroot are obovate, about 5 to 8 mm. long and about 3-4 mm. wide, tapering to a short channelled petiole. They are flesh-colored to light orange, chlorophylless and hypogeal. The color is due to the presence of several laticiferous ducts around each of the five to seven primitive wood bundles which branch out palmately from the petiole, and come together again at the rounded or obtuse apex.

†† Parkinson, J., Theatrum Botanicum, (1640). p. 327.
§§ Morison, R. Historia Plantarum, (1680). Part I, p. 257.
§ Plukenet, L. Almagestum Botanicum, (1696). p. 280.

The seeds are exalbuminous containing a large raphe along one side; they are black and smooth. After germination the empty seedcoat is found indifferently on the ends of the cotyledons, or on the apex of the first leaf. Often it falls off in the process of germination. When three cotyledons are present, their shape does not vary, but they are smaller than the usual two. The cotyledons wither in a few weeks.

The first leaf is palmately veined, orbicular in outline, cordate at the base devoid of any lobes, but with just the indication of an obtuse prominence at the apex. As the succeeding leaves appear the second year a small lobe develops at the apex. Even the first leaves may when vigorous or when older become slightly wavy margined. Variations in the length of the petiole of the leaf, and its replacement have already been referred to.

The most interesting part of the Bloodroot seedling is the hypocotyl. When just come out of the seed this organ does not seem to differ from that of ordinary seedlings where it is present. It contains a four rayed radial wood bundle as in the typical root. The bundle is surrounded by an endodermis and within this the pericycle. Secondary development begins in a few days and after the first leaf has reached the light and expanded, the xylem portion of the bundle increases rapidly in area. Secondary tissue as pith appears in the centre. The hypocotyl at first swells out greatly due to rapid growth and multiplication of the cells in the cortex; after a week or two this outer growth slackens and the subsequent thickening is mostly due to the enlargement of the pith. The mestome strands in the older rhizome which is developed from the hypocotyl, do not increase in great numbers, but soon are scattered in the circle of the cambium. The interfascicular cambium is well developed.

Lubbock* in his work on seedlings refers to somewhat similar enlargements of the hypocotyl of seedlings. The first case is that of our common radish, *Raphanus sativus,* Linn., the thickened edible "root" of which is developed from the hypocotyl.† The root stock of *Cyclamen persicum,* Mill, is likewise developed from the hypocotyl.‡ In *Testudinaria elephantopes* Burch.‖ a similar embryonic thickening is recorded. This plant seedling seems to be entirely rootless for a time. The upright rootstock of Cyclamen, the thickened primary "root" of the radish, and the rhizome of Bloodroot are then developed

* Lubbock, J. A Contribution to Our Knowledge of Seedlings, 2 vols. 1892.
† Ibidem. Vol. I, p. 178.
‡ Ibidem. Vol. II, p. 184.
‖ Ibidem. Vol. II, p. 576.

from the embryonic organ, the hypocotyl. In the case of the Bloodroot the hypocotyl soon twists around horizontally and becomes an elongated creeping structure, the rhizome. As it grows new leaves and scales from year to year, buds are left behind and these account for the branching of the older rhizomes. The twisting around of the hypocotyl may be noticeable within the first week of growth.

The primary root, or the continuation of the underground hypocotyl does not seem to increase in thickness at all. As the hypocotyl assumes its horizontal position, the primary root and its branches become soon aborted and wither away. This twisting and also the gradual disappearance of the first root is strikingly evident in the series of plants in the accompanying illustrations. Secondary adventitious roots soon develop from the lower side of the horizontal hypocotyl now become the new rhizome. All the roots of Bloodroot after the second year are undoubtedly adventitious. Lubbock reports such adventitious roots on the seedlings of *Begonia villosa*, Lindl.§ at an early stage of growth.

Examination of plants older than two years has not been systematically made, so that there is no direct evidence as to the manner in which the older rhizomes branch. It is not even known to us whether the buds may not be adventitious, though this is not likely. In any case, the lengthening out of the rhizomes is a very slow process under ordinary circumstances and extended and continued systematic study of older plants is necessary. The size and number of the lobes of the leaf seem to have some connection with the age of the plants and this fact too has not been investigated.

Conclusions:

1. The cotyledons and hypocotyl of our form of Bloodroot, *Sanguinaria mesochora*, Greene, are hypogeal and chlorophylless.
2. The rhizome or rootstock of the plant is developed from the horizontally twisting hypocotyl, which increases in thickness, at first by enlargement in the cortical area, and later in the center or pith of the single radial bundle.
3. The primary root soon dies, at least before the second year, and all the roots of older plants are adventitious.

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§ Ibidem. Vol. II, p. 2.

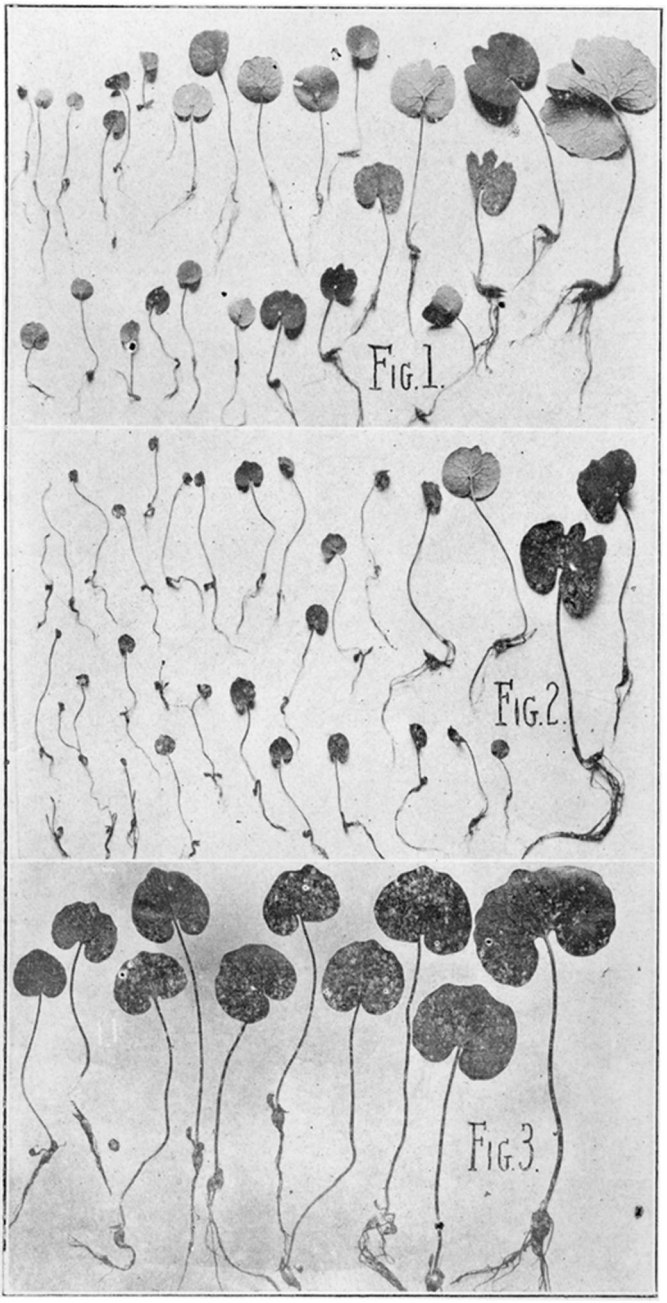

PLATE XV NIEUWLAND ON BLOODROOT.
Figs. 1 and 2 about ¼ natural size.
Fig. 3 One half natural size.

Photo by J. Huerkamp